Development of Dummy-Based Seating Procedures

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Background

- To enhance occupant protection, there is a need to start looking at other injuries
- Ankle injuries are common and major cost to the society
- Need a way to measure injury to lower legs and ankle injuries
- Current lower legs do not have instrumentation in the ankles
- Current seating procedures places the foot and ankle in a non-neutral position (non-human-like)

Enhanced Lower Legs (Thor-Lx and -FLx)

- Thor lower legs can be used to measure lower extremities injury for both the 50th and 5th female dummies.
- Three rotations at the ankle
  - Inversion/eversion (X axis)
  - Plantar flexion/dorsiflexion (Y axis)
  - Internal/external rotation (Z axis)
- Have a preferred "neutral" position (0, -15, 0 deg) – which allows for a more realistic foot angle

Current Seating Procedures Used in FMVSS 208

50th Percentile Male Dummy (standard/Denton lower legs)

- Seat at mid-track, lowest height and position
- Seat back angle set by manufacturer
- Right foot on accelerator pedal
- Left foot on footrest, or toe on toeboard, or flat on floor pan

5th Percentile Female Dummy (standard/Denton lower legs)

- Seat at full-forward, mid angle, lowest height
- Seat back angle determined by head level
- Right foot on accelerator pedal
- Left foot is flat on toe pan

Enhanced Lower Legs and Current Seating Position

- When dummy is placed in mid track, the THOR legs possibly may not achieve the neutral position.
  - The feet are sometimes put in dorsiflexion when placed on accelerator pedal and/or footrest
  - Pre-loading of ankle/foot is undesireable
- Determined we need to research a new seating procedure

Assumptions about Human Seating

- What do people do when they get in an unfamiliar vehicle?
  - Move the seat back
  - Get in the seat, adjust the height
  - Move seat forward till foot reaches the pedals
  - Adjust seat back until head is level

Dummy Based Seating Positioning Goals

- Seat the dummy based on vehicle footwell and size of occupant
- Repeatable procedures
- Right foot in contact with accelerator pedal
- All feet in neutral positions, without any pre-loading of the feet
- All heels are on the floorpan

Seat and Feet Final Positions

- Determine the driver seat track location based on the right
  - heel on the floor pan
  - foot contacting the accelerator pedal
  - foot in the neutral position
- Determine the passenger seat track location by getting feet
  - close to the firewall
  - neutral
- Avoid placing driver's left foot on brake or clutch pedals
- Left foot is placed symmetric to the right foot

Driver Procedure Summary

- Start with the seat full rear, cushion at mid-angle
  - Position dummy's H-Point and pelvis at this location
  - Place dummy's feet in neutral
- Aim right foot towards the accelerator pedal
- Move left foot to avoid overlap with any pedals
- Move forward till right foot contacts accelerator pedal
- Adjust the left foot to be
  - symmetrical about midsaggital plane or
  - limited by contact with side-wall or foot-rest
- Adjust the seat back to make head level

Examples of Driver's Side Footwell Layouts





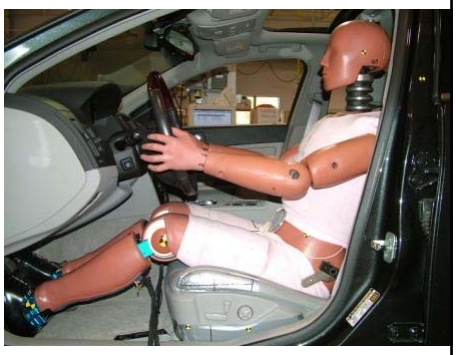

Passenger Procedure Summary

- Start with the seat full rear, cushion at mid-angle, feet together
- Pitch toes downwards towards the floor
- Move forward till feet touch toepan or seat is full forward
- Lift toes back up to neutral position
- Move forward (if possible)
- Spread feet apart symmetrically until either contact with interior or knees 10.6” apart (6.7” for 5th F)
- Adjust the seat back to make head level

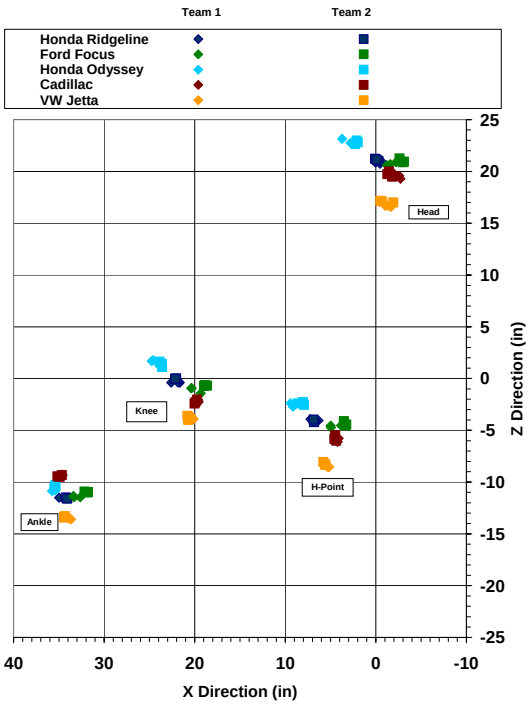
Examples of Passenger’s Side Footwell Layouts

50th Percentile Male Procedure Development

- Vehicles used in the study
  - 2002 Ford Focus
  - 2005 Cadillac STS
  - 2005 VW Jetta
  - 2005 Honda Ridgeline
  - 2005 Honda Odyssey



50th Male Driver-Repeatability, Reproducibility



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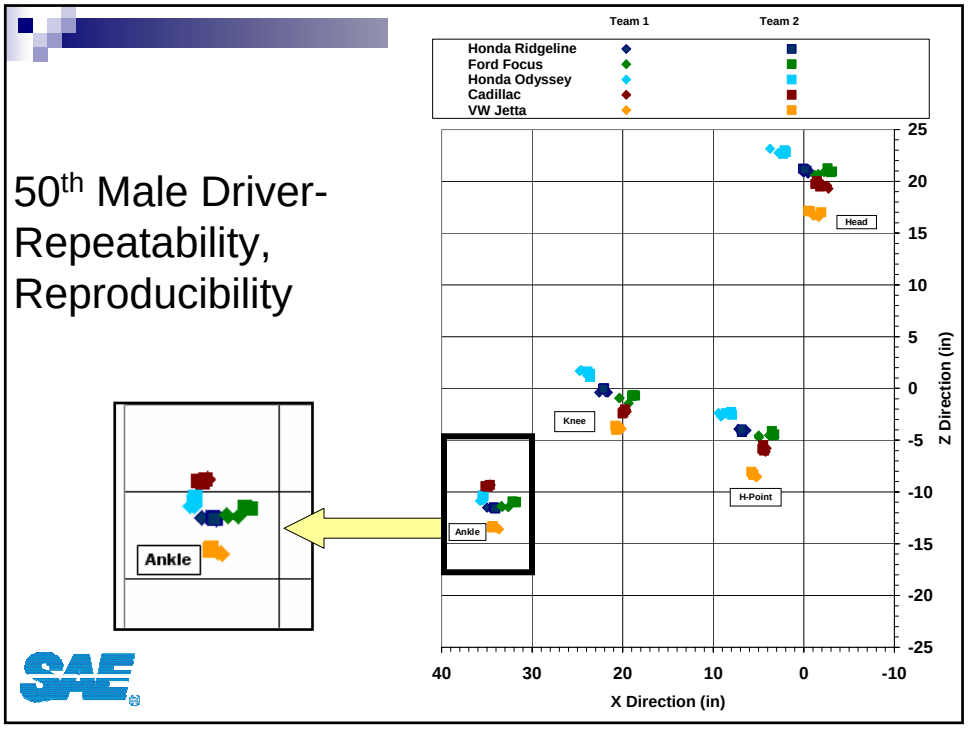

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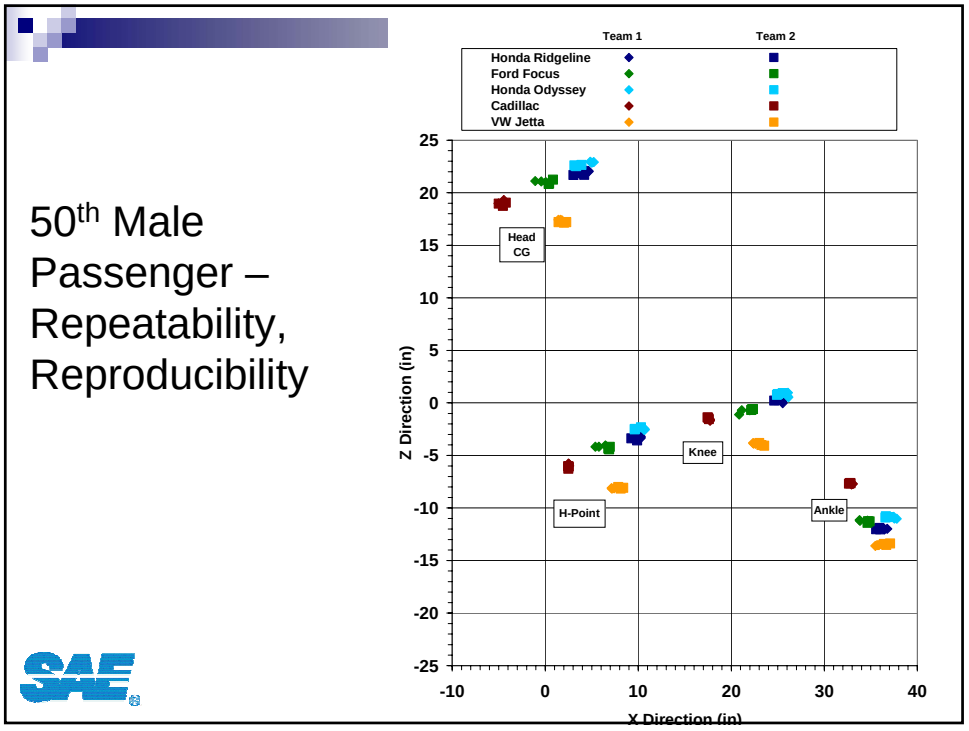

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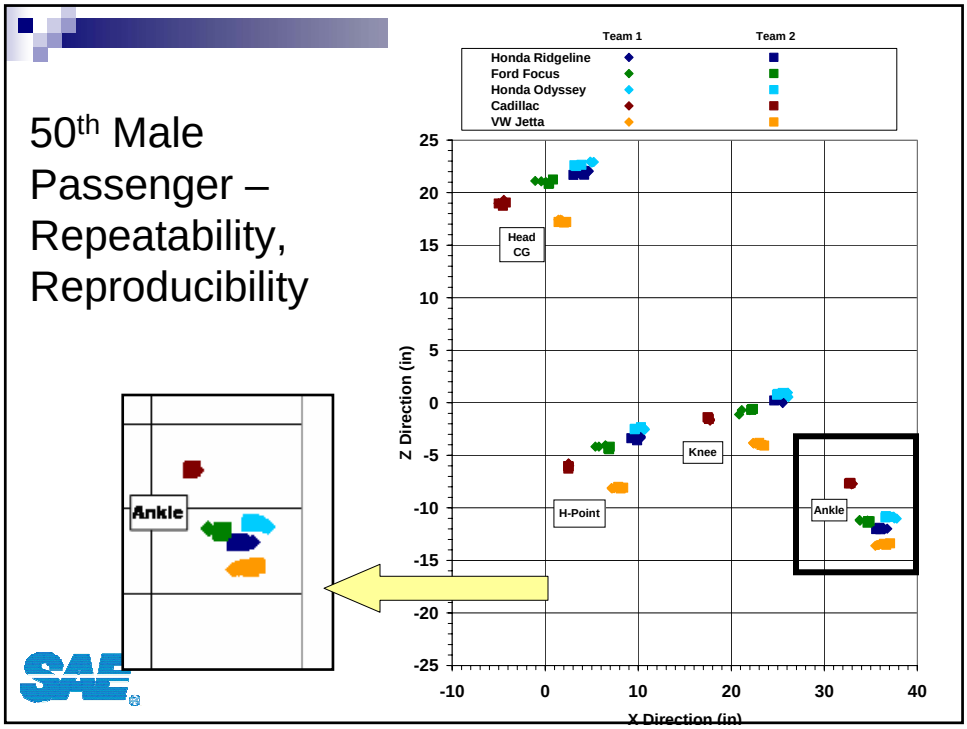
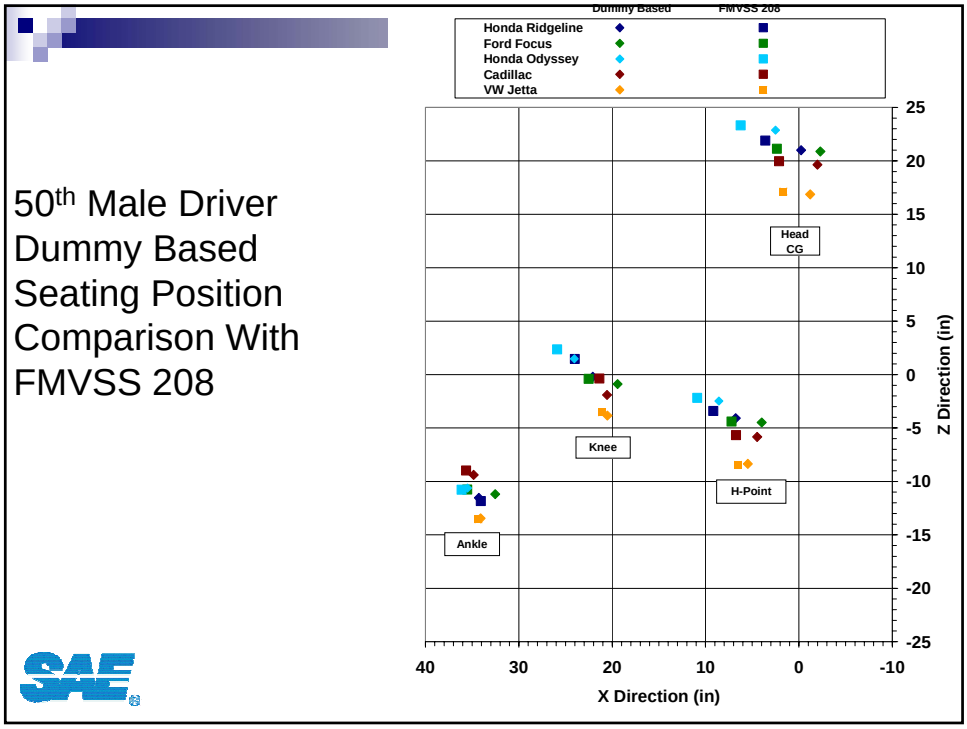


50th Male Driver Dummy Based Seating Position Comparison With FMVSS 208



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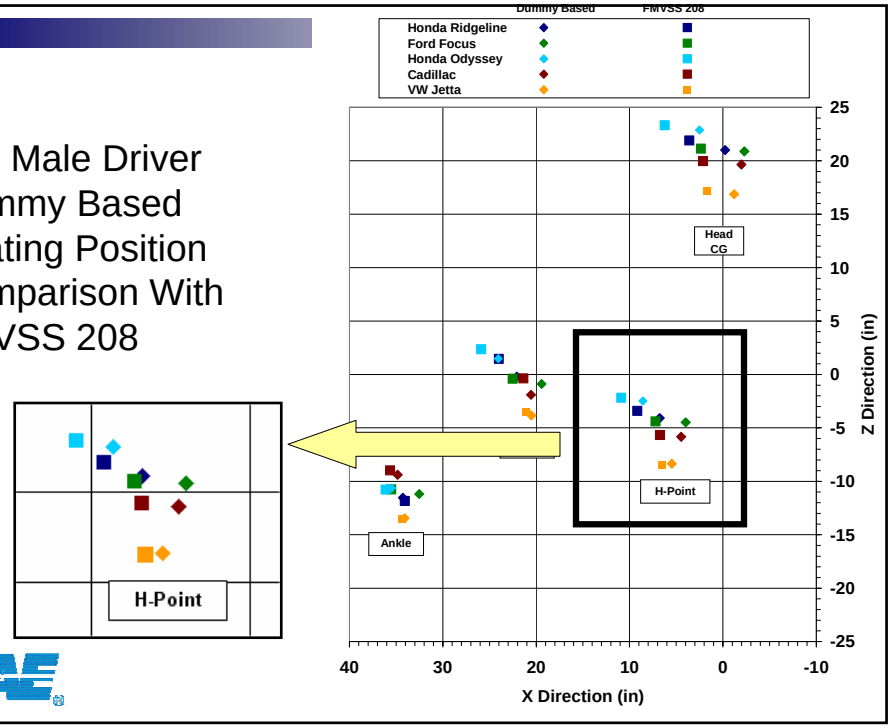
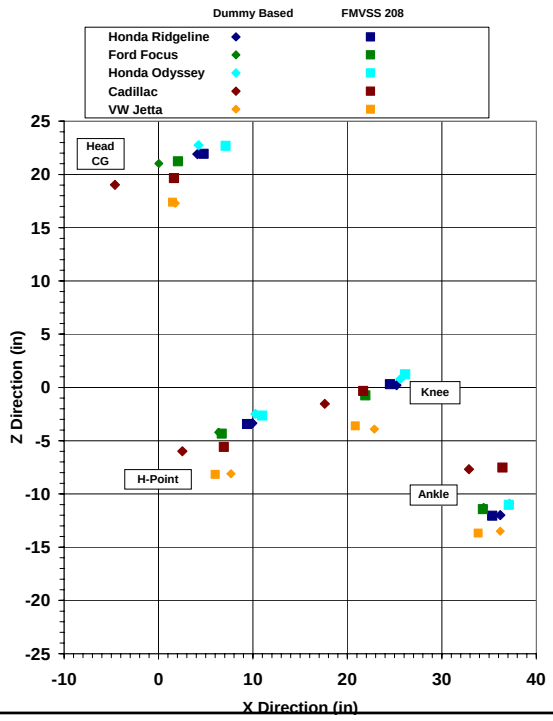


50th Male Pass. Dummy Based Seating Position Comparison With FMVSS 208



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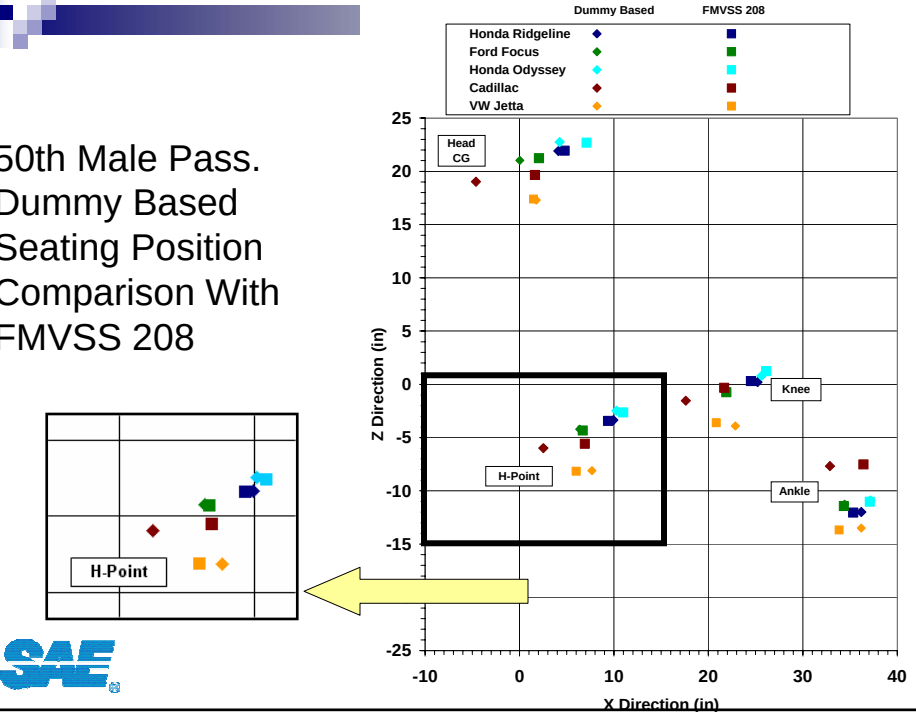
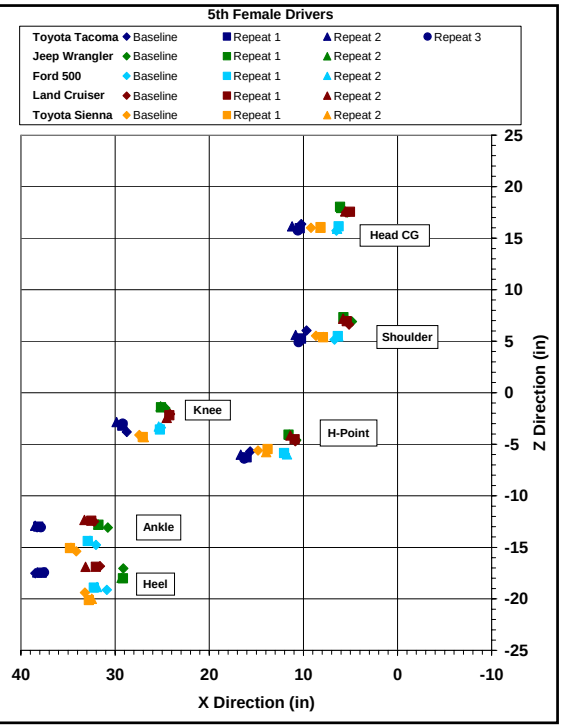


5th Percentile Female Seating

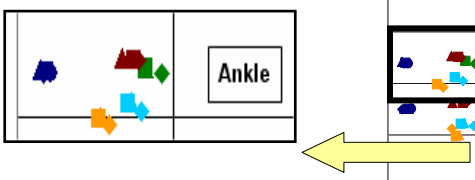
- Vehicles used
  - 2005 Ford 500
  - 2006 Toyota Tacoma
  - 2007 Toyota Landcruiser
  - 2005 Toyota Sienna
  - 2002 Jeep Wrangler
  - 2005 Saturn Ion**
  - 2004 Honda Accord**

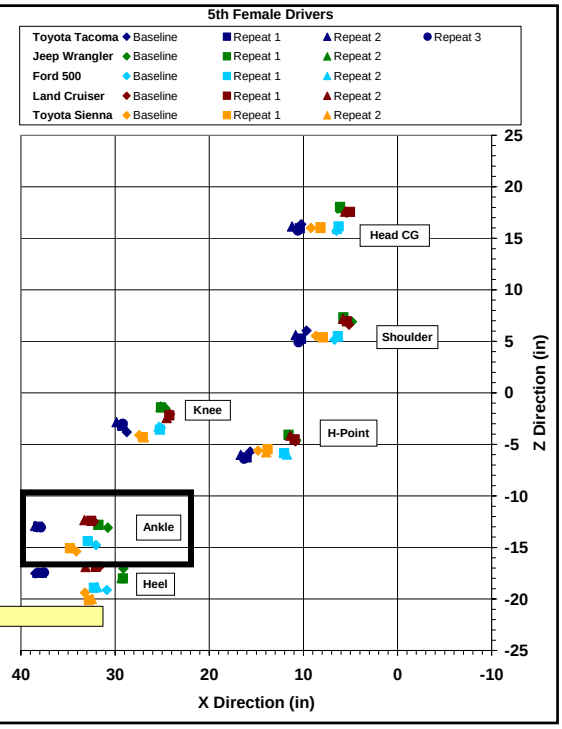
** No repeat tests for these vehicles

5th Female Driver – Repeatability

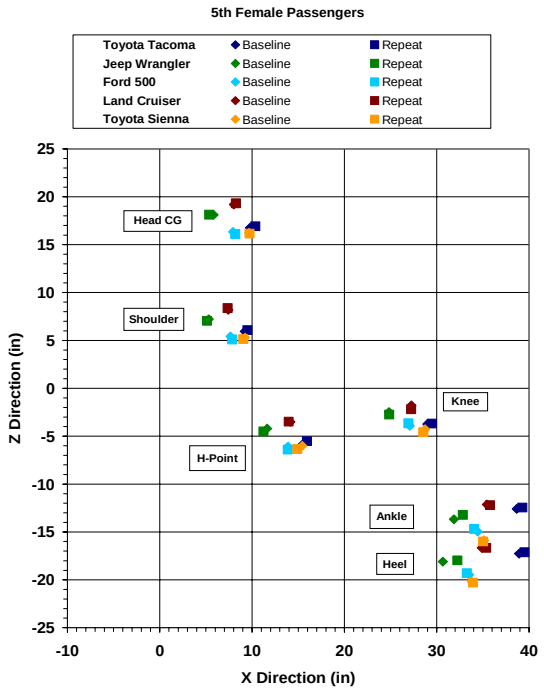


5th Female Driver – Repeatability





5th Female Passenger – Repeatability



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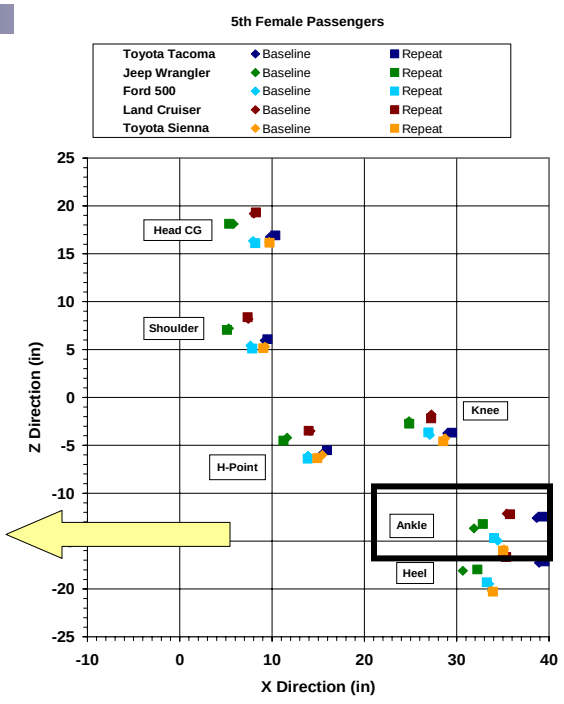
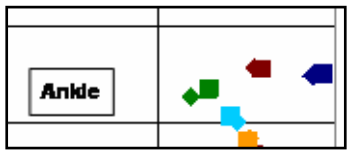
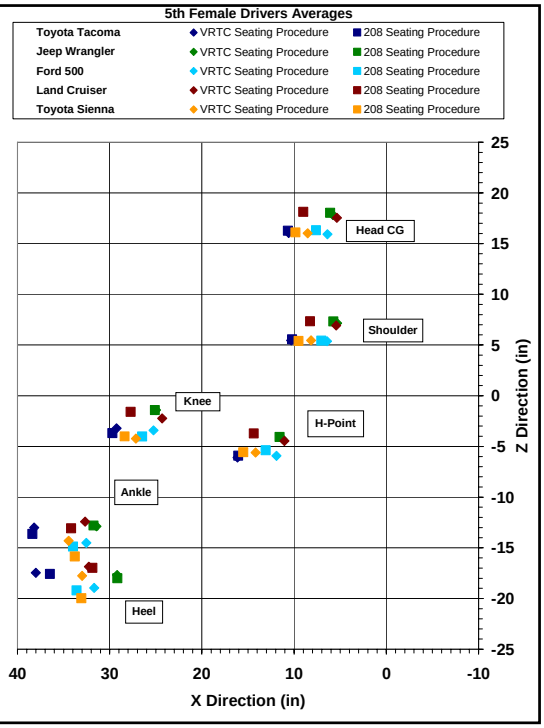
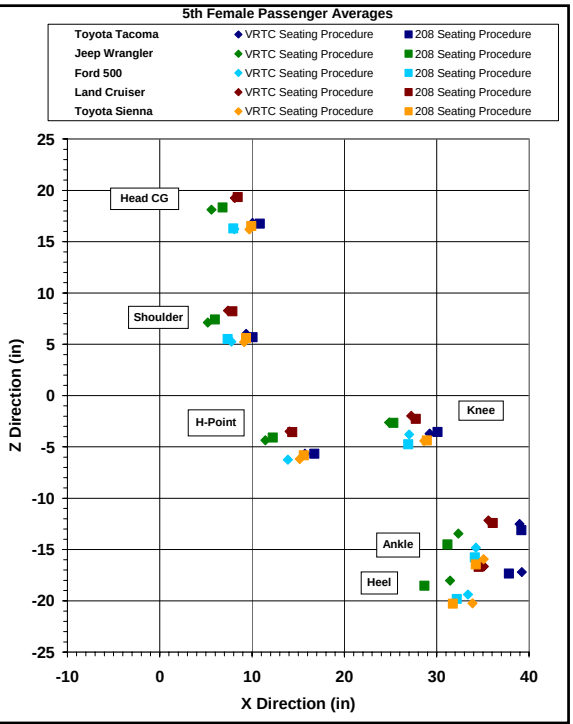




5th Female Driver Dummy Based Comparison with FMVSS 208



5th Female Pass. Dummy Based Seating Position Comparison with FMVSS 208



Observations

- Use of Thor legs adds complexity – but are usable and valuable tools
- Repeatability of dummy-based is similar to mid-track/full-forward procedures
- Dummy-based procedures more likely to have:
  - thighs on the seat
  - heels on the floorpan
  - feet in neutral
  - right foot on the accelerator pedal

Observations Continued

- 50th Male
  - Dummy's left foot is not always on the footrest
  - Driver seat is usually rear of mid-track
- 5th Female
  - Seat position was sometimes slightly rearward of full forward
  - Feet in neutral

Thanks for your attention!

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